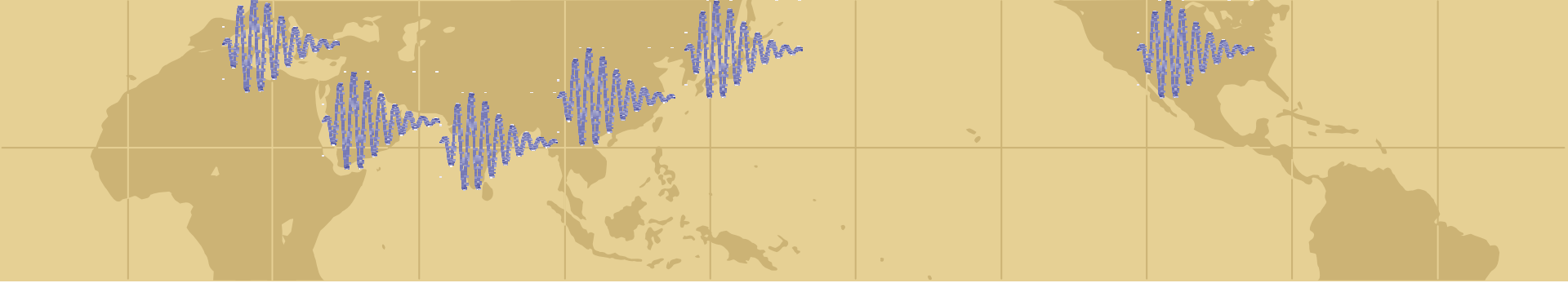


Status of Loran-C Evaluations Federal Aviation Administration

Mitchell J. Narins
Systems Engineer, Navigation Integrated Product Team
AND-702

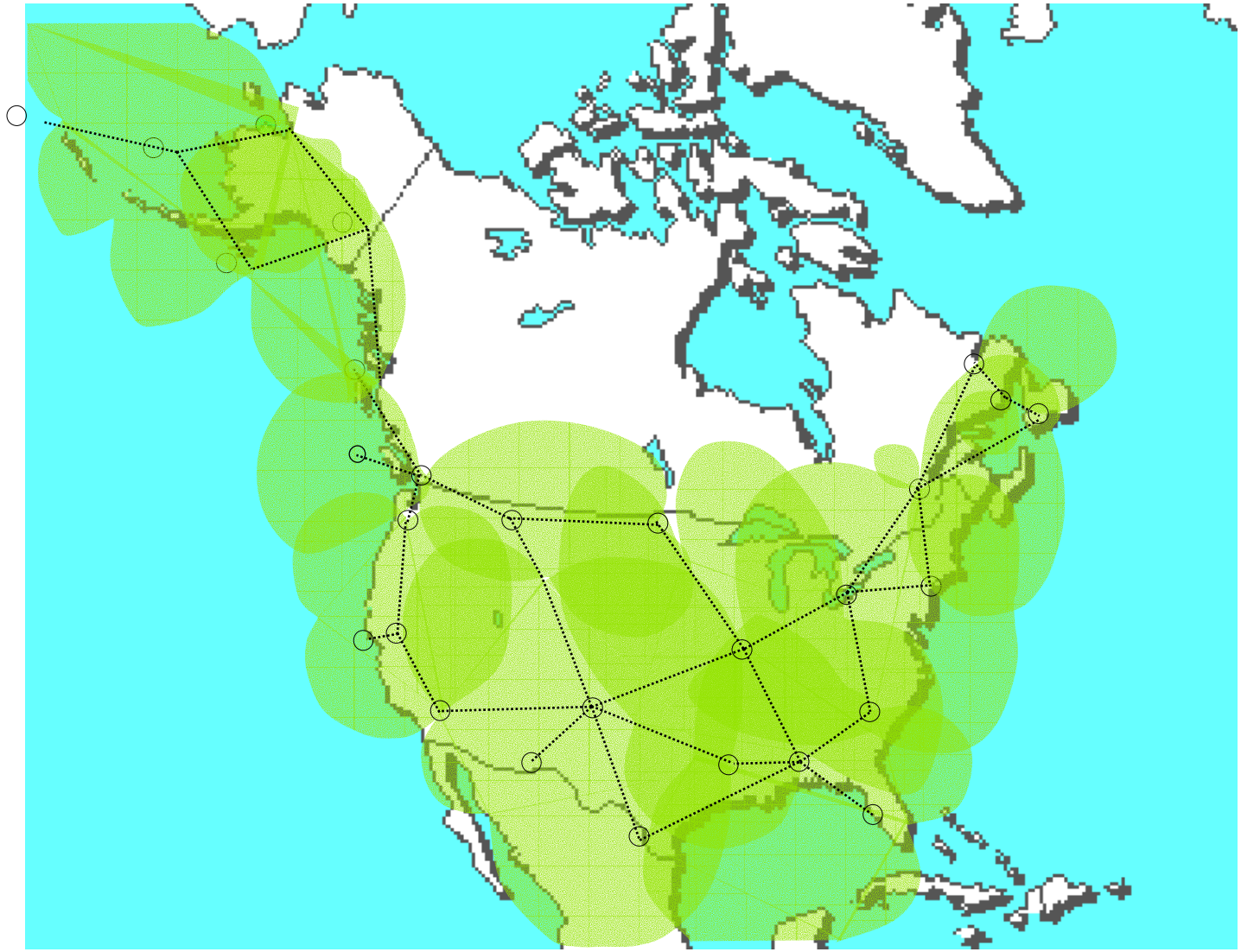
Workshop on Integrated CNS technologies for Advanced Future Air Transportation Systems

Hosted by the Space Communications Program at NASA Glenn Research Center - May 1st – May 3rd, Cleveland, Ohio

Loran-C in the NAS Today

- Loran-C may be used as a navigation source in both en-route and terminal airspace under both visual flight rules (VFR) and instrument flight rules (IFR).
- No Loran-C approach procedures currently exist in the National Airspace System (NAS).

US Loran-C Chain Coverage



US Loran-C Policy Evolution

- FY 1996
  - The U.S. Federal Radio-navigation Plan (FRP) announces the intent to terminate Loran-C operations on December 31, 2000.
  - The Coast Guard Authorization Act of 1996 required DOT to prepare a report on the future use and funding of Loran-C.
- FY 1998
  - The Administration began discussions in 1998 on the continuation of Loran-C.
- FY 2000
  - FY 1999 FRP states that Loran-C will be “operated in the short term” while its long-term requirement and cost-effectiveness are evaluated.

US Policy Evolution (2)

"While the Administration continues to evaluate the long-term need for continuation of the Loran-C radionavigation system, the Government will operate the Loran-C system in the short term. The U.S. Government will give users reasonable notice if it concludes that Loran-C is not needed or is not cost effective, so that users will have the opportunity to transition to alternative navigation aids. With this continued sustainment of the Loran-C service, users will be able to realize additional benefits. Improvement of GPS time synchronization of the Loran-C chains and the use of digital receivers may support improved accuracy and coverage of the service. Loran-C will continue to provide a supplemental means of navigation. Current Loran-C receivers do not support nonprecision instrument approach operations."

- ***Para 3.2.5 B 1999 US Federal Radionavigation Plan***

US Policy Evolution (3)

- FY 2001
  - Administration/FAA submitted $20 million budget request.
    - Both House and Senate committees raised Loran-C funding to $25 million.
  - FAA working with USCG during FY 2001 to determine capability of Loran-C to provide landing service with required availability, accuracy, integrity, and continuity.
  - FAA will brief USDOT on potential benefits to aviation in using Loran-C following FY 2001 evaluations.
  - FAA and USCG is assessing and will project costs of operating and re-capitalizing the system if continuation of system is warranted.

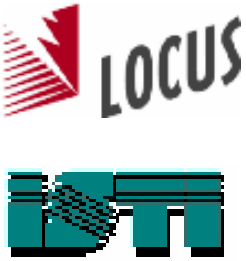
US Program Participants

- US Government
  - Federal Aviation Administration
    - FAA HQ
      - Navigation Integrated Product Team
      - Flight Standards/System Certification
    - FAA Technical Center
      - CNS Test and Evaluation
  - US Coast Guard
    - USCG HQ
    - USCG Navigation Center
    - USCG Loran Support Unit

US Program Participants(2)

- Academia
  - US Coast Guard Academy
  - Ohio University
  - Stanford University
  - University of Rhode Island
- Industry
  - Peterson Integrated Geo-positioning
  - Locus, Inc.
  - Illgen Simulation Technologies

Program Logo Collection

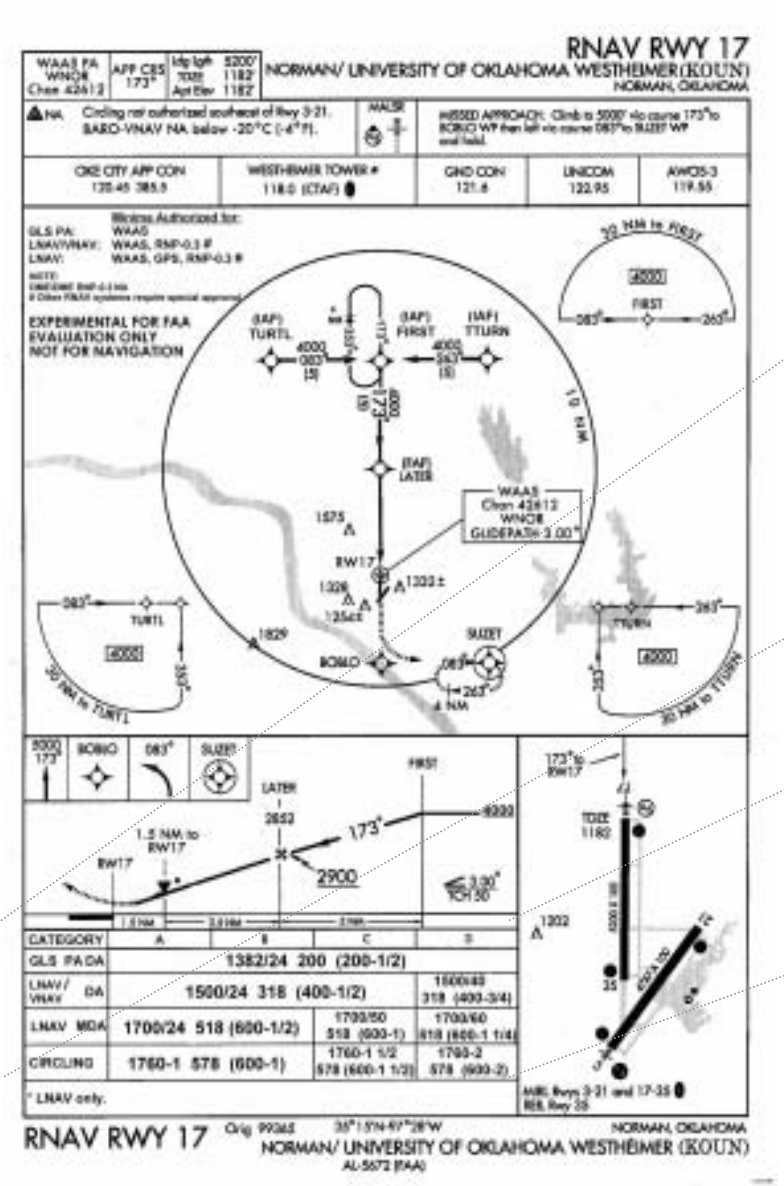


Loran-C Program Goals

- Determine if an enhanced Loran-C system can meet the
  - Availability
  - Accuracy
  - Integrity, and
  - Continuity

  requirements to support Lateral Navigation (LNAV) during the approach phase of flight, including missed-approach guidance
- Determine whether Loran-C can provide other ancillary benefits to aviation

Example of an RNAV Chart



CATEGORY	A	B	C	D
GLS PA DA	1382/24 200 (200-1/2)			
LNAV / VNAV DA	1500/24 318 (400-1/2)			1500/40 318 (400-3/4)
LNAV MDA	1700/24 518 (600-1/2)		1700/50 518 (600-1)	1700/60 518 (600-1 1/4)
CIRCLING	1760-1 578 (600-1)		1760-1 1/2 578 (600-1 1/2)	1760-2 578 (600-2)

Loran-C Aviation Issues

Issues	Potential Mitigations
Availability	
Precipitation Static	H-Field Antenna
Loss of Station Power	UPS
Lightning	New Lightning Protection
Chain Availability	All-in-view receivers
Tube overloads	Solid-state transmitters
Accuracy	
Old timing sources	New cesium clocks
Old timing equipment	New timing suite
Tube technology	Solid-state technology

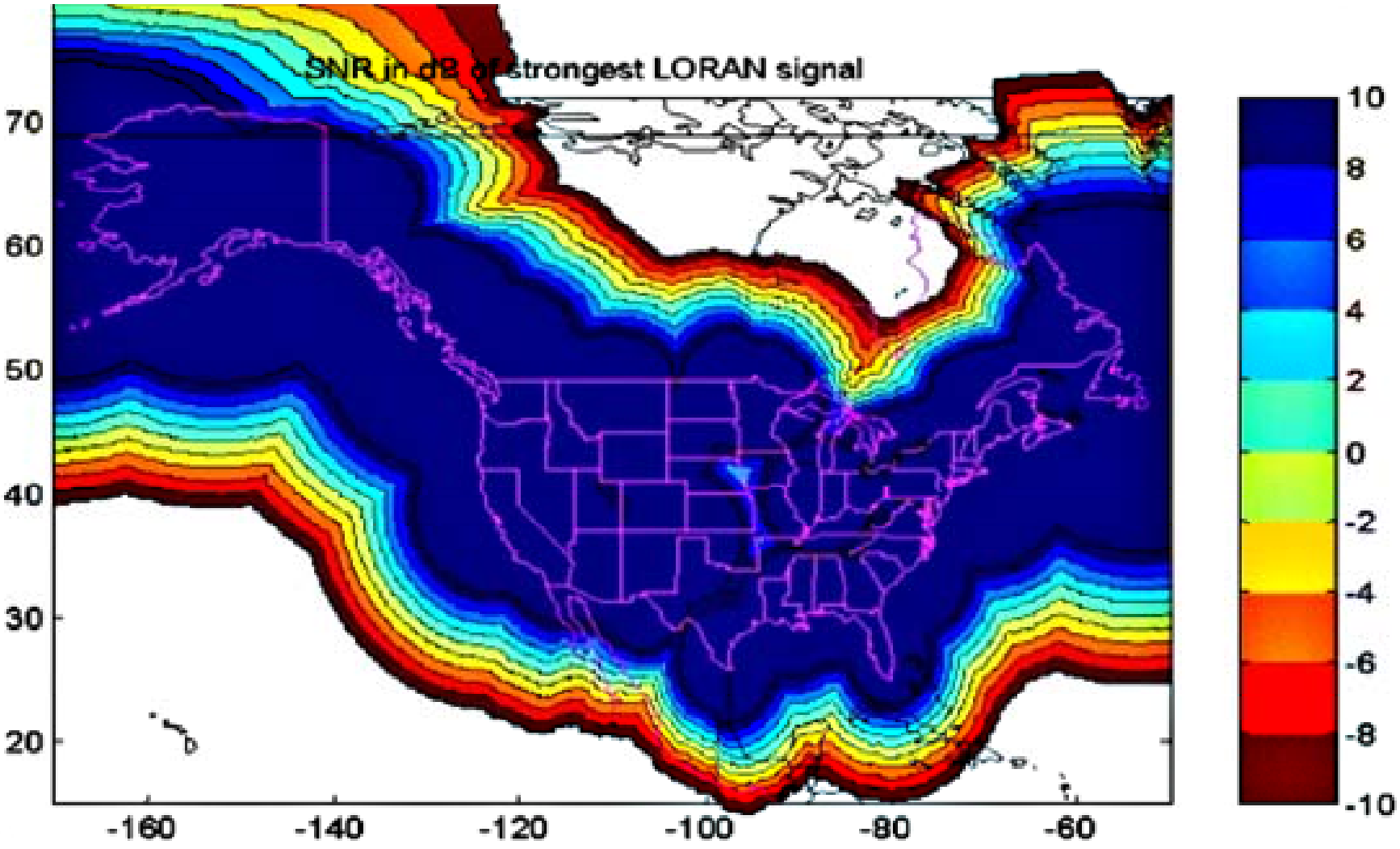
Loran-C Aviation Issues (2)

Issues	Potential Mitigations
Integrity	
Manual System	Automatic Blink System (ABS)
Continuity	
Triad-based approaches	All-in-view navigation
Receiver acquisition time	New DSP technology

Other Potential Benefits

- Loran-C has the potential for providing a transmission path for GPS correction information [i.e., Wide Area Augmentation System (WAAS)] corrections.
  - Potential for providing WAAS signal in areas where geo-stationary satellite coverage is limited, questionable, or unavailable (e.g., Alaska, urban canyons)

Potential Loran-C Comm Capability



Status of FY 2001 Activities

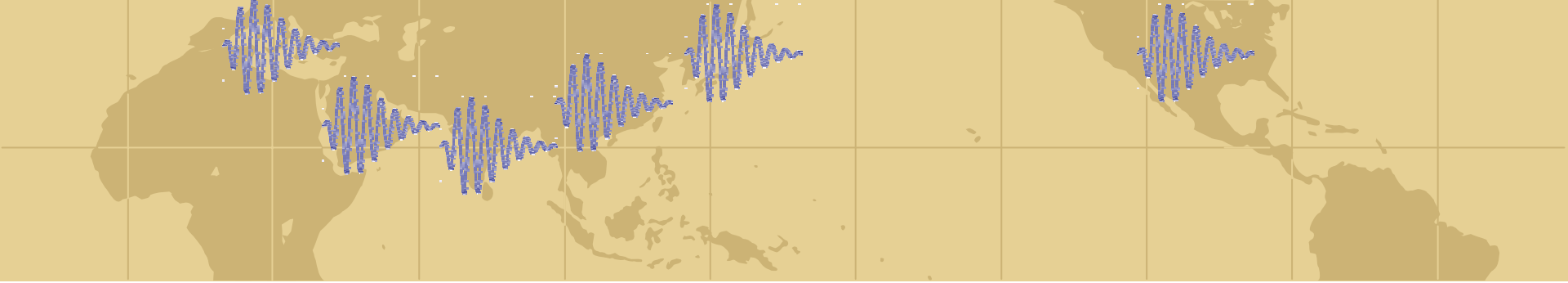
- Flight Testing of H-Field antennas and all-in-view receivers
  - Original testing schedule (Fall 2000) delayed to ensure safety of aircraft static charging system, installation of field mill and measurement equipment, and aircraft structural considerations
  - Testing now scheduled for June 2001
- Testing of all-in-view DSP receivers
  - Preliminary testing on-going at US Coast Guard Academy and Ohio University
  - Tests will be integrated with tests at FAA Technical Center
  - Post-processing algorithms being developed to potentially improve navigation performance

Status of FY 2001 Activities (2)

- Loran Data Channel development
  - USCG Loran Support Unit, Stanford University, Peterson Integrated Geo-positioning, and University of Rhode Island have made remarkable progress in this area.
  - Using Inter-pulse Frequency Modulation (IFM) a 250bps data rate is being achieved.
  - Initial on-the-air testing March 2001
  - Flight trials planned during May and June 2001
  - Alaskan on-site test/demonstration and flight trials planned for August 2001.

Status of FY 2001 Activities (3)

- Future Plans
  - Work with USCG to develop FY 2002 Project Plan, to include
    - Evaluation and quantification of Loran-C navigation and communications benefits to aviation and other transportation modes
    - Continued re-capitalization of Loran-C system and quantification of Loran-C operational cost reductions
  - Share tests results with navigation community as they become available
    - ION
    - GNSS
    - ILA
  - Brief RTCA on results of test and evaluation, as promised
  - Report results of test and evaluation and recommended near-term course of action to USDOT (mid-FY2002)




FEDERAL AVIATION ADMINISTRATION


PRODUCT TEAM FOR NAVIGATION AND LANDING
FAA

Questions